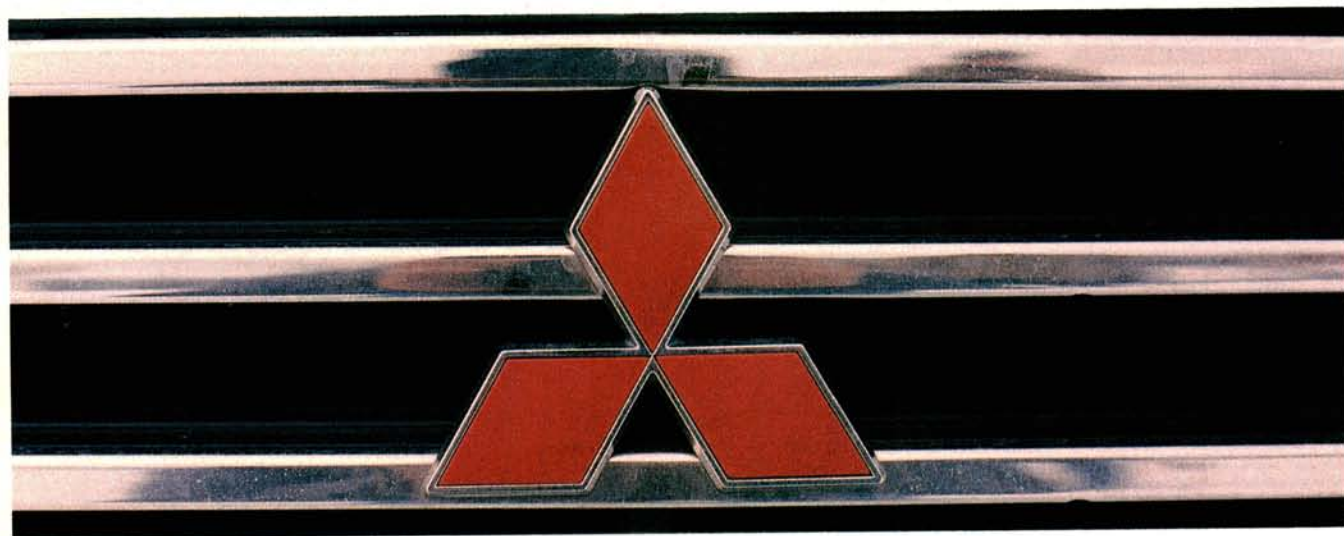


# Mitsubishi Silent Shaft Timing Chain Replacement



The four-cylinder engine has become the standard engine in a growing percentage of today's cars. Even larger and heavier cars are using four-cylinder engines. To handle the increased loads, the engine has had to grow along with them. You've heard the old saying "If a little bit is good, more is better." "More" only works up to a certain point with four-cylinders.

Above a displacement of about 2.0 liters, vibration begins to become a problem on four-cylinder engines. The up and down motion of the two pairs of pistons and connecting rods produces what's called vertical secondary vibration. This vibration becomes increasingly noticeable as displacement rises above the 2.0 liter threshold.

Mitsubishi has devised a clever solution to this problem. Two small balance shafts (Mitsubishi calls them Silent Shafts) are utilized to cancel the engine's secondary vibration. They accomplish this by generating their own opposing secondary vibration which masks the vibration produced by the pistons

and rods.

The two shafts turn at the same speed as one another, but in opposite directions. The right Silent Shaft is driven off the oil pump gear and turns opposite crankshaft rotation. Both Silent Shafts rotate at twice crankshaft speed.

To maintain their vibration cancelling characteristics, the Silent Shafts must stay in proper timing with the crankshaft. A separate set of gears and a chain are used for this purpose. Using this design has allowed Mitsubishi to increase its four-cylinder engine displacement to 2.6 liters.

The engine used for our photographs was in a 1980 Dodge Challenger. This engine has been used in several models produced for Chrysler by Mitsubishi over the years. These include Dodge D-50 and Plymouth Arrow trucks, Plymouth Sapporo, and others. It's even turned up in some of Chrysler's domestically produced models.

Mitsubishi began marketing cars in the U.S. under



its own name during the 1983 model year. The company has continued to use Silent Shafts (now called Dual Engine Stabilizers). The 1989 Starion, Montero, Truck, and Wagon/Van models currently use this design. Mazda borrowed a 2.6 liter version of this engine from Mitsubishi beginning in 1987 for use in their B2600 pickup. This engine gets around!

The Silent Shaft timing chain is located in front of the camshaft timing chain and must be removed before removing the camshaft timing chain. The camshaft timing chain is a stout, double roller chain, and is usually trouble free.

It's the single roller Silent Shaft chain which most often causes problems. Spinning the oil pump along with the two heavy Silent Shafts puts a pretty big strain on the narrow roller chain. There's no automatic adjustment to compensate for wear as the chain stretches.

The looser it gets, the more likely it is that problems will occur.

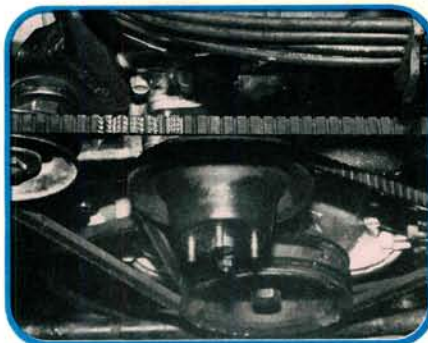
Give the Silent Shafts a careful inspection, especially if the car has higher mileage. Both shafts are hollow and lubricate their rear bushings through internal passages. The rear bushing on the left Silent Shaft is the last part to receive lubrication from the oil pump. Low oil pressure or oil passage restrictions may prevent this bushing from receiving proper lubrication.

The extra drag caused by worn shaft bushings could be the reason why the Silent Shaft timing chain failed in the first place. Better check the shaft bushings out now rather than later. This article will detail the replacement and proper timing of both the camshaft timing chain and the Silent Shaft chain.

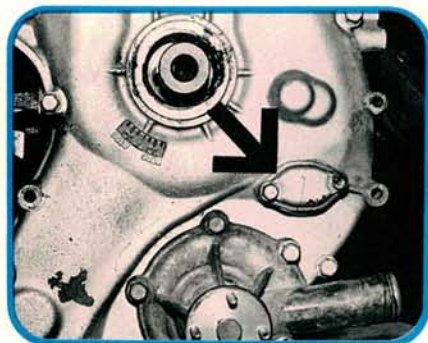
—By Karl Seyfert



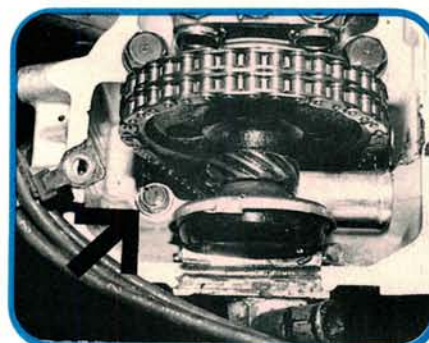
Since this engine has been used in so many different cars, we'll discuss the initial steps of the job only in general terms. No matter what you're working on, you'll need to make room for yourself at the front of the engine. Disconnect the battery and drain the cooling system. Remove the fan, fan shroud, and radiator.



Turn the engine to TDC on cylinder number one. Remove the drive belts and the water pump pulley. Remove the crankshaft pulley. Remove any brackets attached to the front cover. Note front cover bolt locations. They're several different lengths. Remove the remaining front cover bolts and the front six oil pan bolts.

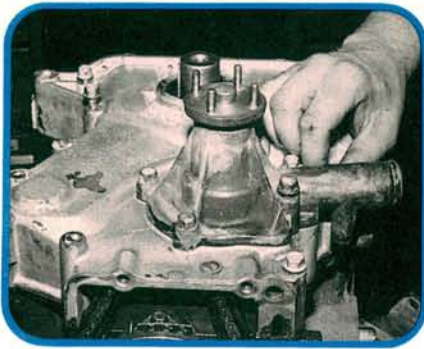


The water pump can stay in place during front cover removal. None of its mounting bolts extend through the timing cover. This small access hole (arrow) allows you to adjust the Silent Shaft timing chain tension without having to remove the timing cover. Properly maintained chain tension will prolong chain life.



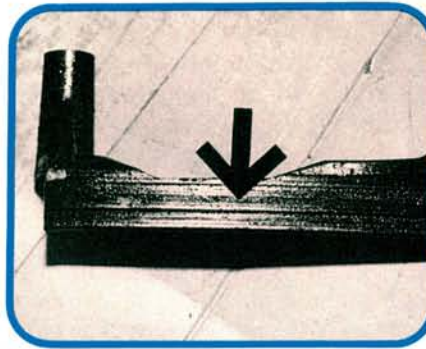
Mark the position of the distributor, then remove it. Remove the valve cover along with the front oil seal and breather hose. Remove the camshaft bolt and distributor drive gear. Slide the cam gear off the cam and rest it on its holder. Remove the two bolts securing the front of the head to the front cover.





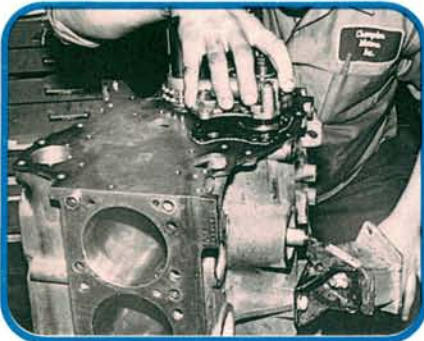
# 5

Remove the remaining bolts from the front cover, then slide it straight out. It may be necessary to loosen additional pan bolts to make enough room for the cover to squeeze out. Separate the head and pan gaskets from the cover with a sharp scraper to avoid damaging them as the cover is removed.



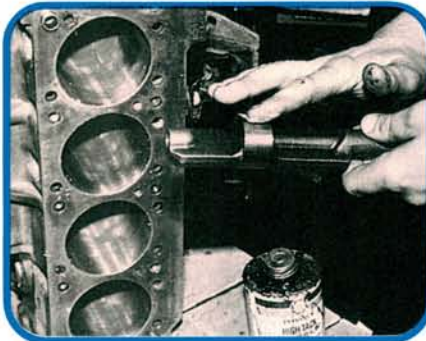
# 6

Remove all timing chain parts and check everything carefully for wear. The chain guides will develop wear grooves like these and can also become brittle and break off. A broken piece of chain guide will bring everything to an abrupt halt inside the front cover. Don't take a chance; replace any worn parts.



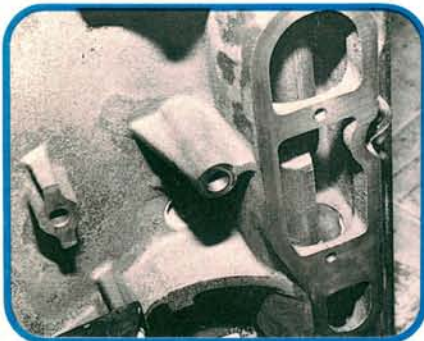
# 7

This engine was getting a complete overhaul so the Silent Shafts were removed. If your engine has high mileage, check the shafts and their bushings for wear at this time. The right shaft is attached to, and driven by, a gear on the oil pump. Remove the right Silent Shaft and oil pump as an assembly.



# 8

Coat the right Silent Shaft bearing journal surface with assembly lube. Lower the oil pump/Silent Shaft assembly into place. Keep it straight to avoid damaging the Silent Shaft bushing in the block. Reinstall the oil pump bolts and torque them to 8-9 Nm (6-7 ft-lbs).



# 9

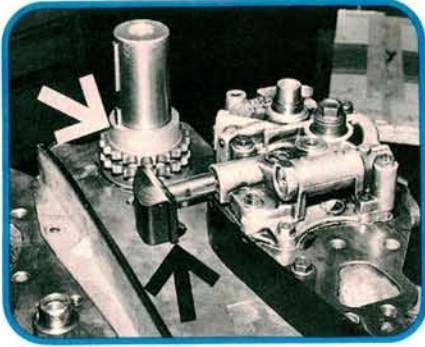
Remove the Silent Shaft chamber cover from the left side of the block. Inspect the Silent Shaft bushing in the block for wear and replace it if necessary. During reinstallation, guide the Silent Shaft by reaching into the block through the cover opening. This will prevent damage to the bushing.



# 10

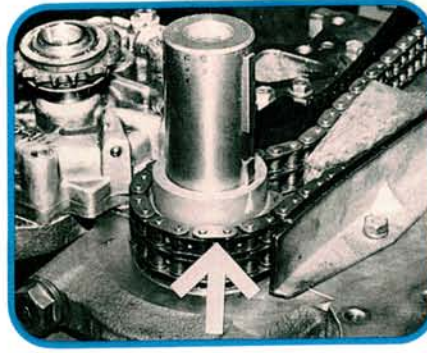
Inspect the left Silent Shaft thrust plate (arrow) parts for wear. Replace the O-ring seal on the thrust plate. Coat the O-ring and the Silent Shaft bearing journal with assembly lube. Install two pilot bolts in the thrust plate mounting bolt holes. Don't damage the O-ring seal by twisting it during installation.





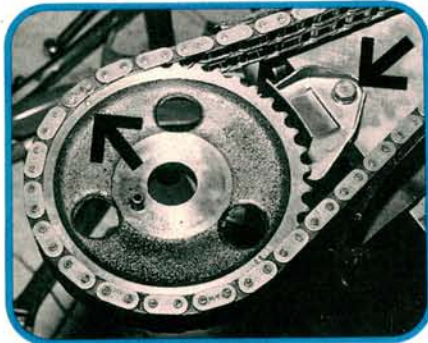
# 11

Reinstall the left Silent Shaft chamber cover. Torque the bolts to 4-5 Nm (3-4 ft-lbs). Reinstall the Woodruff keys in the crankshaft. Install the crankshaft timing gear (white arrow) with its shoulder facing out. Reinstall the timing chain guides. Install the spring and chain tensioner (black arrow) in the oil pump.



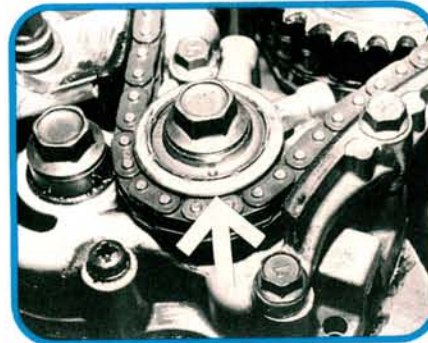
# 12

Locate the two plated links on the timing chain. With the crankshaft at top dead center, the timing marks on both the crankshaft and camshaft gears will be on the left side of the engine. Slip the chain over the crankshaft gear and match the plated chain link to the timing mark in the gear.



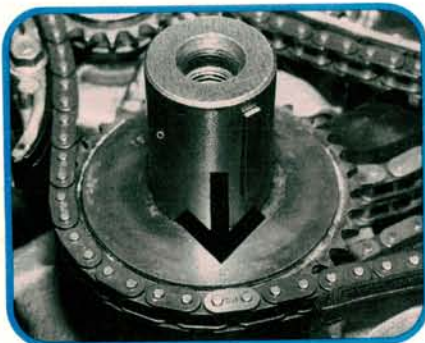
# 13

Use a chain wedge to hold the chain in position while the camshaft gear is reinstalled. Match the timing mark (left arrow) on the camshaft gear to the plated chain link. The gear holder (right arrow) below the camshaft gear supports the gear and makes a chain wedge unnecessary during cylinder head removal.



# 14

At first glance, the two Silent Shaft timing gears look almost identical. Their timing marks are on opposite sides of the gears, however. The right Silent Shaft gear (arrow) is installed with its convex surface facing up. The left Silent Shaft gear is installed with its concave surface facing up.



# 15

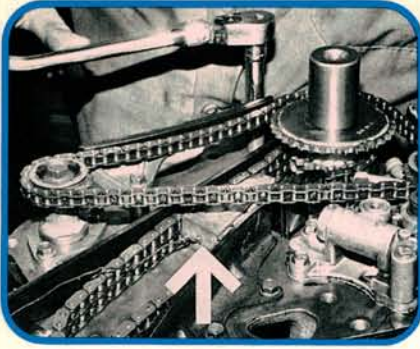
The Silent Shaft timing chain also uses plated links for setting the gear timing. Match the plated chain link to the crankshaft gear timing mark, then install the gear over the crankshaft Woodruff key. Match the plated chain link to the right Silent Shaft gear timing mark, then install the gear to the oil pump.



# 16

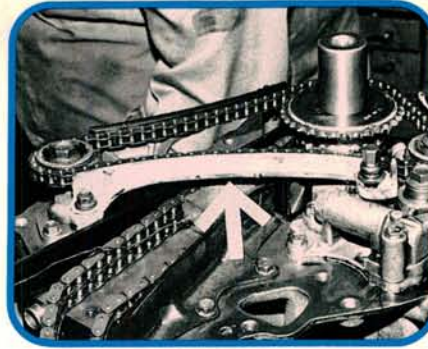
Match the plated chain link to the left gear timing mark. Install the gear spacer and Woodruff key on the left Silent Shaft. Turn the shaft until the key lines up with the slot in the gear, then install the gear. Install both Silent Shaft timing gear retaining bolts and torque them to 29-39 Nm (22-28 ft-lbs).





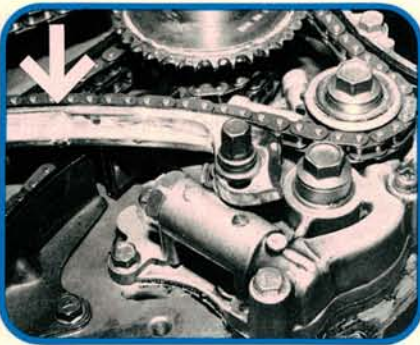
# 17

Reinstall both of the lower Silent Shaft chain guides. Worn guides should be replaced. Several different bolt lengths are used on the chain guides. The lower guide shares a bolt with the left cam chain guide. The chain wedge (arrow) keeps everything in position while the Silent Shaft gear bolts are tightened.



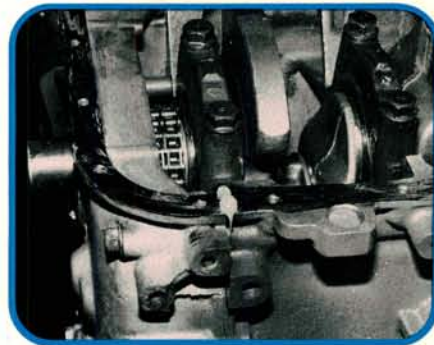
# 18

Install the upper timing chain guide (arrow). Leave the mounting bolts loose at this time. Turn the right Silent Shaft gear clockwise until all the slack is removed from the chain between it and the crankshaft gear. Turn the left Silent Shaft gear counterclockwise to remove its slack also.



# 19

All the Silent Shaft timing chain slack should be in the upper section of the chain between the two balance shaft gears. Insert a feeler gauge between the chain and the center of the upper chain guide (arrow). Move the upper chain guide to obtain a clearance of 1-3 mm (.04-.14 in), then tighten the bolts.



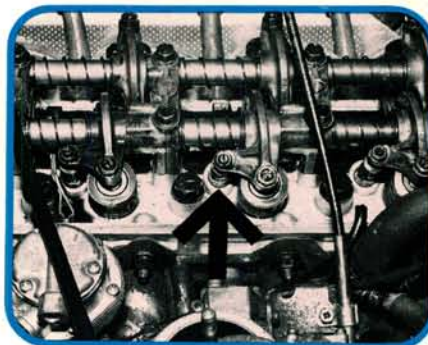
# 20

The hardest part about doing this job without removing the head is jockeying the front cover back into position. Loosen the side oil pan bolts to make more room. If the pan gasket is in really bad shape, you may have to remove the pan and replace the gasket. What did we do before they invented silicone sealer?



# 21

Replace the crankshaft pulley seal if you haven't already. Reinstall the front cover bolts. Reinstall the six pan bolts in the front cover, then torque all the pan bolts to 6-7 Nm (4.5-5.5 ft-lbs). Reinstall the crankshaft pulley and tighten it to 108-127 Nm (80-94 ft-lbs). Reinstall all remaining parts.



# 22

Never short on ingenuity, Mitsubishi also includes small auxiliary intake "jet valves" on this engine. Later versions have hydraulic lash adjusters for the intake and exhaust valves. The intake jet valves (arrow) are mechanically actuated and still require adjustment. Don't overlook these during maintenance.